Appendix D
City of San Diego Metropolitan Wastewater Department
Operations and Maintenance Division
Pilot Study Report

California Environmental Protection Agency
Environmental Management System Project

1.0 Pilot Description

The City of San Diego Metropolitan Wastewater Department, a public agency, manages the resources to operate the Metropolitan Sewerage System, which treats the wastewater generated by 16 area cities and districts. They serve 2.2 million customers generating approximately 180 million gallons of wastewater daily. By the year 2050, an estimated 3 million people will generate a wastewater flow of 340 million gallons per day.

The Operations and Maintenance Division (O&M Division) within the Metropolitan Wastewater Department operates and maintains several wastewater collection and treatment facilities, manages an operating budget of $70 million and employs over 300 people. While the facilities are to some degree managed as well as regulated as separate entities, they are interconnected in that performance at one typically impacts performance at another.

The O&M Division operates and maintains the following facilities.

- Point Loma Wastewater Treatment Plant
- North City Water Reclamation Plant
- Metro Biosolids Center
- Pump stations PS1, PS2, PS64, PS65, East Mission Gorge, and Penasquitos
- Metropolitan Operations Center

The Point Loma Wastewater Treatment Plant, located near the tip of Point Loma, treats most of the sewage generated in the San Diego area—a 450 square mile region from Del Mar and Poway to the north, Alpine and Lakeside to the east and south to the Mexican border. Point Loma has a treatment capacity of 240 million gallons per day. The North City Water Reclamation Plant provides an additional 30 million gallons a day of treatment capacity for the northern San Diego region and reclaimed water for irrigation and industrial use to supplement the water supply—90% of which is imported. The Metro Biosolids Center provides thickening and digestion of raw sludge from the North City Water Reclamation Plant and dewatering of blended wet biosolids from both the North City plant and the Point Loma plant. The Metro Biosolids Center took the place of the former Fiesta Island Sludge Processing Facility. Biosolids are transported to a landfill with gas collection and energy recovery. The South Bay Water Reclamation

Plant, with a treatment capacity of 15 million gallons per day, began operation in 2002 and is scheduled for ISO 14001 certification in May 2003.

This pilot project is classified as a recently-implemented EMS for purposes of addressing the research questions. The O&M Division implemented an ISO 14001 EMS, certified in May of 1999 with scope expansions in October 2000 and February 2001. They achieved the distinction of becoming the first publicly owned treatment works in the U.S. to certify to the ISO 14001 EMS Standard.

Pilot Project Management

The O&M Division within the City of San Diego Metropolitan Wastewater Department (MWWD) was selected as a Cal/EPA pilot project in June 2000. The Project Manager for Cal/EPA is Renée Lawver, a Senior Scientist with the California Integrated Waste Management Board. Previous Cal/EPA Project Managers for this Pilot were Gordon Innes and Gina Kathuria, of the State Water Resources Control Board. The primary O&M Division contact is Linda Jones, the management representative in charge of the environmental management system at the time of this study. Jim Lindsay of the O&M Division tracked data relating to San Diego's targeted impacts. Chris Toth, currently the Collections Division Deputy, participated in Cal/EPA EMS Working Group meetings during his tenure as O&M Division Deputy. It was under Chris Toth's leadership that the EMS was initiated, implemented, and certified. Bill Lopez served as Deputy Director until March 2002. John Paschall is the Energy Coordinator for Metropolitan Wastewater Department and oversees data collection and reporting related to energy use and expenditures. The energy coordination function is provided by the Engineering and Program Management Division.

History of Environmental Management at the O&M Division

Prior to 1943, the City of San Diego had no wastewater treatment facilities. Raw sewage was discharged into San Diego Bay and the Pacific Ocean through about 20 outlets. In 1943, a 14 million gallon per day wastewater treatment plant was constructed near downtown San Diego and enlarged in 1950. The current system, with its various facilities was put into operation and subsequently upgraded over an extended time period.

In 1963, the Point Loma Wastewater Treatment Plant began operation. An extension to the Point Loma ocean outfall was commissioned in 1993.

Federal Clean Water Act grant and state and local monies built the 300,000 gallons per day aquaculture plant in Mission Valley in 1984. Aquaculture is a created aquatic ecosystem that removes pollutants from wastewater. In 1993, the aquaculture operations moved to a larger location in the San Pasqual Valley and the facility was built with a treatment capacity of 1 million gallons per day. The aquaculture plant received the American Association of Water Reclamation Agencies Award for Creative Technology in 1989.

The predecessor to the Metropolitan Wastewater Department, the Clean Water Program for greater San Diego, was originally established in 1987. The City of San Diego Metropolitan Wastewater Department was created in 1994.

The North City Water Reclamation Plant began operation in 1997.

In 1998, Metro Biosolids Center began operation and was named the winner of the San Diego's Taxpayers' Association Fiscal Watchdog Award for its privatization of the cogeneration system. A private company built and operates the cogeneration facility at Metro Biosolids Center which makes use of methane collected from both the Metro Biosolids Center and the Miramar landfill gas collection system. Also in 1998, San Diego City Council authorized the City's Public Contract Operations, known as the "bid to goal" program developed collaboratively by MWWD, the City Manager, the City Optimization Program, the San Diego Municipal Employee Association, and the American Federation of State, County and Municipal Employees--Local 127. This effort measures City operations against private sector benchmarks. This same year, the California Public Utilities Commission deregulated electrical energy sales.

At the time the decision was made to certify to the ISO 14001 Standard, some City services were being evaluated for privatization. Division management wanted to support the organization in its efforts to become increasingly competitive and provide better service for customers. The plan-do-check-adjust cycle with its emphasis on gradual change was expected to be a valuable change management framework as the Division also works to maintain ties to the past through rigorous documentation and record keeping protocol. In addition to other management initiatives at the time, Division management made the decision to benchmark and continually improve environmental management system performance with the independent review gained from third party certification and surveillance auditing.

In May 1999, the original ISO 14001 certification was achieved for the following seven facilities:

- Point Loma Wastewater Treatment Plant,
- North City Water Reclamation Plant,
- Metro Biosolids Center,
- San Pasqual Aquaculture Plant (closed December 2001),
- Pump Stations 1 and 2, and
- Metro Operation Center 2.

This achievement distinguished San Diego MWWD O&M as the first publicly owned treatment works in the U.S. to be certified to the ISO 14001 EMS Standard. The gas utilization facility came online at Point Loma in June 1985, making the facility energy self-sufficient and enabling them to sell power back to the grid. The facility was re-powered during 1998-1999 to handle the increased treatment plant energy demand and returned to operation in November 1999.

The following five facilities were included in the ISO 14001 certification scope expansion in October 2000:

- Pumping Stations 64 and 65,
- Penasquitos and East Mission Gorge, and the
- Metro Operation Center 3 repair facility.

In February 2001, the National Biosolids Partnership EMS was integrated into O&M Division's ISO 14001 EMS. The hydroelectric generator came on-line at Point Loma in June 2001 to take advantage of the 90 foot drop in elevation of the effluent discharged from the plant to the ocean outfall. This project generates up to 1.35 megawatts for sale to the electric grid. This same year, the remote control system for emergency generators was put into operation to provide 2 megawatts of power to help prevent Stage III power emergencies and rolling blackouts.

The City of San Diego was awarded the 2001 Program Excellence Award for Innovations in Local Government from the International City/County Management Association for the "Bid to Goal" program and reported $53 million in savings by the O&M Division. Savings are attributed to streamlining existing processes, centralizing maintenance and warehouse functions, emphasizing preventive maintenance, developing more efficient procurement and inventory control practices, improving the tracking of budgets and expenditures, and implementing employee incentive programs.

Two ongoing environmental protection issues which concern the MWWD are (1) the Clean Water Act waiver extension to allow continued advanced primary treatment of influent as opposed to requiring secondary treatment and (2) ongoing raw sewage spills from collection lines. Both these issues are outside the scope of the O&M Division EMS. These issues are described briefly here to emphasize the importance of understanding the realities and implications of an EMS fence-line or EMS scope.

A five-year waiver from secondary treatment requirements of the Clean Water Act was granted to the City of San Diego in 1995. The waiver requires proof that the treated effluent is not harming the environment. As of mid-April 2002, the U.S. EPA has tentatively approved a waiver extension for five more years. The Coastal Commission has rejected the application. The draft permit issued by the U.S. EPA and the RWQCB includes a required monitoring program by MWWD to measure the impact of the wastewater discharge on the marine environment, demonstrate compliance with applicable water quality standards, and measure toxic substances in the discharge. These activities are outside the scope of the O&M Division EMS, which is the subject of this case study.

The Collection Division has experienced significant spills from sewage collection lines located in remote canyons. Sanitary sewer overflows are the responsibility of the Collection Division and not the O&M Division, hence these events are outside the scope of the O&M Division's EMS and outside the scope of this study.

2.0 Project Objectives

The pilot project with San Diego was conducted in order to meet the following objectives specified in AB 1102 (Stats. 1999, Ch. 65) codified in Public Resources Code, Section 71045 et seq.

Objective 1 Whether and how the use of an environmental management system (EMS) by a regulated entity increases public health and environmental protection over their current regulatory requirements[1]; and

Objective 2 Whether and how the use of an EMS provides the public greater information on the nature and extent of public health and environmental effects than information provided by their current regulatory requirements[2].

To the above, the Cal/EPA added the following objectives:

Objective 3 Evaluate economic indicators to determine incentives and barriers to EMS implementation

Objective 4 Identify challenges and successful examples of EMS implementation

Further, each pilot participant had one or more additional pilot-specific objectives. The pilot -specific objective for the O & M Division is as follows:

Objective 5 Describe observations on the EMS development and implementation experience for a government organization as well as the experience gained during the first cycle of continual improvement.

In the following sections, each objective will be paraphrased. For example, Objective 1 is referred to as simply environmental protection. The term environmental protection is intended to capture protection of both environmental and public health.

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[1] Protection provided by current regulatory requirements is defined as those protections provided through the issuance, enforcement, and monitoring of any permit, requirement, authorization, standard, certification, or other approval issued by a federal, state, regional or local agency to the regulated entity for the protection of the public heath or the environment (PRC § 71046(a)(1)).

[2] Information provided by current regulatory requirements is defined as that information provided through the issuance, enforcement, and monitoring of any permit, requirement, authorization, standard, certification, or other approval issued by a federal, state, regional or local agency to the regulated entity for the protection of the public heath or the environment, or any other law or regulation governing the disclosure of public information (PRC § 71046(a)(2)).

3.0 Project Methodology

Over the study period, Linda Jones provided information about the O &M's EMS through completion of the UNC National Data Protocols and the California Protocol. Renée Lawver reviewed the protocols and, where protocol data were insufficient to answer the research questions, interviewed Linda Jones, Jim Lindsay, John Paschall, and Chris Toth to gain a better understanding of the subtleties of EMS implementation and performance improvements. Ms. Lawver attended a management review meeting and was a silent observer at a third-party audit performed by ABS, the registrar for San Diego O&M's EMS. During the external audit, Ms. Lawver observed operations at the Metro Biosolids Center and the Point Loma wastewater treatment facility.

In addition, San Diego hosted a Southern California EMS Working Group meeting on April 4, 2001, at which they explained their processes, material flows, EMS, and provided a tour of the North City water reclamation plant. Chris Toth returned to participate in the hosted meeting as well as the final Statewide EMS Working Group workshop on October 17, 2001 to provide his historical perspective on San Diego's O&M Division EMS implementation experience. The exchange of questions and answers provided some additional information for this case study. The history of environmental management was based on materials published by the Metropolitan Wastewater Department, press releases from U.S. EPA, and articles in the L.A. Times.

Objective 1 Environmental Protection

To determine whether and how improved environmental protection resulted from EMS implementation three primary categories of information were evaluated.

1. Awareness and commitment
2. Systematic management of environmental impacts
3. Environmental performance indicators

Awareness and Commitment refers to the scope of environmental issues the organization manages.
Staff reviewed and analyzed the following measures of awareness and commitment:

1. The presence of an environmental policy.
2. Demonstrated knowledge and understanding of environmental laws, regulations, and other requirements.
3. Demonstrated knowledge and understanding of the environmental impacts of the organization.
4. Documentation of objectives and targets for environmental protection improvements.

Systematic management of environmental impacts refers to the ability of an organization to better protect the environment through a more mature and effective system of environmental management.

Staff reviewed and analyzed the following measures of systematic management for environmental protection:

1. Documented implementation strategies and responsibilities designed to meet regulatory requirements, manage significant aspects, and achieve objectives and targets for improved environmental protection.
2. Measures to assess environmental performance.
3. Audit and review processes to assess the performance of the management system and make system adjustments in order to continually improve environmental performance and protection.

Environmental performance indicators are the most quantitative and direct way of measuring changes in environmental protection. Key environmental indicators are the direct performance measures of an EMS. Examples include energy use, water use, solid and hazardous waste reduction, air emissions, and quality of water discharge. An analysis of key environmental indicators provides information as to whether an EMS improves environmental protection.

Project staff reviewed and analyzed data in the following areas to determine whether the EMS improved environmental protection.

1. Progress towards objectives and targets,
2. Pre- and post-EMS environmental performance
3. Performance beyond regulatory requirements
4. Compliance performance

Objective 2 Environmental Information

Staff analyzed the following two factors to determine whether and how an EMS provides greater environmental information to the public was accomplished.

1. The extent of public and stakeholder involvement in EMS development, implementation, and review and
2. The degree of improvements in the accessibility and quality of environmental information available to the public as a result of EMS implementation.

The level of public and stakeholder involvement in EMS development, implementation and review indicates changes in communication practices as well as a new and evolving role for stakeholders to effect improvements in environmental protection. Involvement provides avenues for stakeholder response to environmental information and feedback to the organization on their performance. This indicator of greater environmental information is measured by evaluating actual stakeholder participation in the Pilot's

EMS and processes in the EMS for outside communication. This information was collected through the National Database, California Protocol and through Cal/EPA Project Manager's observations.

Improvements in the accessibility and quality of environmental information were evaluated using the California Protocols. Improvements in compliance with legal reporting requirements and information sharing beyond legal requirements indicate improved communication to the public. Accessibility and quality--timeliness, relevance, completeness, and credibility--is evaluated to determine whether the EMS results in greater information available to the public.

Objective 3 Economic Incentives and Barriers to EMS Implementation

Economic indicators provide an indication of economic costs and benefits of EMS implementation. Although determining economic impacts of EMS implementation is not a primary objective of the EMS Pilot Project, understanding these impacts is helpful in identifying incentives and barriers to EMS implementation. The economic data is analyzed to determine if the EMS provided savings incentives or increases in the costs of environmental management.

Objective 4 Successes and Challenges with EMS Implementation

In order to capture and describe additional lessons learned from Pentel's EMS experience, challenges and successes were identified through the Cal/EPA project manager's observations, interviews with the primary Pentel contact, and data analysis. Understanding these challenges and successes helps to illuminate the role EMSs can play in improving environmental protection.

Objective 5 Observations on EMS development and implementation experience

In addition to the general objectives of the project, the Cal/EPA Project Manager made observations during data collection, EMS management review, and a registration surveillance audit which provide some insight into the continual improvement of a government sector EMS.

4.0 Discussion and Analysis

Objective 1 Environmental Protection

Awareness and Commitment

Environmental Policy

The Environmental Policy of the O&M Division of the City of San Diego Metropolitan Wastewater Department states:

> "The Division is committed to providing reliable, high-quality, and cost-effective wastewater services to the ratepayers of the City of San Diego, as well as to preserve and protect the welfare of the public and the marine and coastal environment in a responsible and proactive manner."

Specific commitments include:

- Establish and maintain an Environmental Management System;
- Continually improve the Division's environmental practices;
- Comply with O&M Division's regulatory requirements, legal, and other industry standards to which they subscribe;
- Prevent environmental pollution that may be attributable to O&M Division operations and otherwise seek to minimize waste;
- Comply with the principles articulated in the National Biosolids Partnership (NBP) Code of Good Practice; and
- Regularly communicate the policy to all O&M Division staff and provide to regulatory agencies, the public or other interested parties upon request.

The O&M Division's Environmental Policy addresses responsibility through commitment to a "proactive" approach. Management commitment is demonstrated by the signatures of the Director and Assistant Director of MWWD, the Deputy Director of the O&M Division, Assistant Deputy Director of O&M, and the O&M Division Environmental Management Representative, revised February 2000. This most recent revision added the reference to the National Biosolids Partnership Code of Good Practice.

Prior to the EMS, no written commitment from Division-level management was communicated regularly to employees which specified commitment to continual improvement of the Division's environmental practices, compliance with regulatory standards and legal obligations, prevention of environmental pollution, waste minimization, and the Code of Good Practice regarding the biosolids value chain. This articulation of Division-level as well as Department-level commitment would be expected to have some improvement on standard of care practiced by the organization. Following sections describe implementation of the policy and contain the analysis of whether improvement was achieved.

The ISO 14001 Standard requires that the policy be "appropriate to the nature, scale, and environmental impacts of the organization's activities, products or services." The scope of the impacts is not specified in the Environmental Policy; instead, this is established in its aspects and impacts inventory. The scope of the EMS, or fence-line, is defined as the aspects and impacts associated with, or in the control of, O&M Division operations which includes wastewater treatment facilities, major pump stations, and office buildings. In other words, the EMS fence-line or scope describes the organization's acceptance of boundaries of environmental responsibility managed via the EMS. With the integration of the National Biosolids Partnership EMS, the O&M Division expanded its management system to include environmental controls on the entire biosolids value chain, from pollution prevention and industrial waste treatment

programs through the effluent outfall and biosolids disposal, composting, or land application sites.

Knowledge and Understanding of Legal Requirements

The ISO 14001 Standard requirement is as follows:

> "The organization shall establish and maintain a procedure to identify and have access to legal and other requirements to which the organization subscribes that are applicable to the environmental aspects of its activities, products, or services."

Based on the initial gap assessment performed for the O&M Division in 1997 by a consultant, a formal procedure did not exist prior to the EMS. However, as described by the assessment team, access to current environmental statutes, regulations, and permit conditions applicable to O&M Division activities were available at each facility. In addition, the O&M Division was then and remains supported by a permit coordinator from the Environmental Monitoring and Technical Services Division of the Metropolitan Wastewater Department who is responsible for maintaining and updating all operating permits, subscription services for applicable legal requirements and a database to track permit actions, status, and submittal deadlines.

Knowledge and Understanding of Environmental Impacts

An environmental aspect is an element of an organization's activities, products, or services that can interact with the environment. Significant aspects and impacts are determined by the organization based on a self-established standard methodology. Management of all significant aspects is required by ISO 14001. Significant aspects are, therefore, a good indicator of awareness and commitment.

The O&M Division identified thirty-five significant aspects associated with its operations, as shown in Table 1. Fourteen aspects are considered to be beneficial to the environment as they relate to sewage treatment and water reclamation functions, i.e., these functions are necessary to prevent release of untreated or partially treated sewage. Aspects related to wastewater treatment, including some negative aspects such as residual biochemical oxygen demand and solids in treated effluent as well as facility-generated liquid waste sludge, are considered under operational control. Not surprisingly, most of the impacts deemed significant are regulatory impacts, primarily air and water quality impacts. Hazardous material and waste are also deemed significant. The next most frequently identified impact is in the non-regulated area of solid waste generation. Air emissions, water use, energy use and production and material use are also deemed significant. Other significant impacts identified include land contamination, reclaimed water, visual impacts of facilities and worker transportation. Significant aspects were summarized from San Diego Standard Environmental Operating Procedure with approval date May 31, 2000. This version was updated from the original aspects and impacts inventory completed prior to certification.

The exercise of identifying significant environmental aspects and impacts requires priority-setting at the Division level and is a prerequisite to integrating environmental improvement initiatives with budget planning cycles and construction project planning. This exercise helped identify opportunities for proactive management that reliance on regulatory inspections would not be expected to uncover or necessarily communicate to top management. Prior to its EMS, the Division participated in the Department-wide energy program and maintained a paper recycling program in various facilities, but a Division-level management approach to reducing unregulated environmental impacts was put in place as a result of the EMS.

Table 1 Significant Aspects and Impacts

Aspect	Regulated Impacts				Non-Regulated Impacts					
	Air	Water	Haz. Material or Waste	Health & Safety	Air	Water	Solid Waste	Energy	Material/ Resource Input	Other
Removal of pollutants from wastewater via facility operations and management		+								
Residual biochemical oxygen demand and solids in treated effluent		-								
Centrate wastewater		-								
Facility wastewater biosolid discharge		+								
Facility-generated reclaimed water		+								
Highly automated operational control and management oversight of facility wastewater discharge		+								
Facility-generated liquid waste sludge		-								
Operational control and management oversight of major facilities	+	+								
Subcontractor practices	-	-			-		-			- Noise, heavy equip-ment, traffic
Ratepayer water usage/waste practices		-								

Table 1 Significant Aspects and Impacts, continued

Aspect	Regulated Impacts				Non-Regulated Impacts					
	Air	Water	Haz. Material or Waste	Health & Safety	Air	Water	Solid Waste	Energy	Material/ Resource Input	Other
Workplace breathing air (lab, offices, workshop, plant)	-									
Controlled release of odorants to the atmosphere	+									
Release of odorants to the atmosphere in case of treatment system failure	-									
Digester gas flare	-									
GUF emissions	-									
Digester gas release from pressure valves	-									
Pump motor exhaust (stacks)	-									
Odor/wet well foul air exhaust	+/-									
Activated carbon			+							
Chemicals, fuel, lubricants, paint, and waste oil storage			-							
Hazardous spill cleanup solid waste			-							
Office paper/supplies use									-	
Paper waste							-			
Construction waste							-			
Facility-generated hyacinth compost							+			
Screenings/grit							-			
Biosolids (cake/grit)							+/-	+		

Table 1 Significant Aspects and Impacts, continued

Aspect	Regulated Impacts				Non-Regulated Impacts					
	Air	Water	Haz. Material or Waste	Health & Safety	Air	Water	Solid Waste	Energy	Material/ Resource Input	Other
Stormwater collection system										+ land contami-nation
24 hour treatment and discharge operations—spillage of untreated or partially treated wastewater										- land contami-nation
Electrical energy/fuel use								+/-		
Treatment chemicals use									-	
Water usage						-				
Operational control and management oversight of reclaimed water production										+ Product: reclaimed water
Visual impact of facility										+ local environ-mental/ community issues
Worker transportation										+ local environ-mental/ community issues

Data sources: University of North Carolina National Database Report, EMS Design Table 2: Activities, Aspects and Impacts; and Design Update Section 4. Significant aspects from San Diego SEOP, approval date 05-31-00

Objectives and Targets

The O&M set four targets for the year 2000, as shown in Table 2. Electricity use, potable water use, refuse removal and miscellaneous chemical inventory were targeted for five percent reductions over the previous year. New objectives and targets have been set for the fiscal year ending June 30, 2002. Bulk and miscellaneous chemical use will be tracked. Ten percent reduction goals are set for electricity use, potable water use, refuse removal, and a new target for notices of violations received from environmental regulatory inspections.

Systematic Management of Environmental Protection

Documented Implementation Strategies and Responsibilities

The system elements put in place as part of the EMS include the following:

1. Operational controls
2. Emergency preparedness
3. Regulatory compliance assurance
4. Training programs
5. Employee involvement and communication
6. Supply chain management
7. Performance tracking
8. audit and review procedures

These system elements can be expected to improve environmental protection as a complement to regulatory requirements due to the requirement of the ISO 14001 EMS standard to demonstrate effectiveness.

Operational Controls

Operational controls are the operations and activities that are associated with managing significant aspects. ISO 14001 requires that these operations and activities be identified and planned "to ensure they are carried out under specified conditions." The organization must establish and maintain procedures related to the significant aspects of goods and services used by the organization, and communicate relevant procedures and requirements to suppliers and contractors. Work instructions, manuals, and standard operating procedures are examples of operational controls.

Prior to the EMS, development of operational control procedures for critical control points was prioritized based on complexity of the operation. Post-EMS, operational control development priorities are set based on the degree of significance of the environmental impact under normal operating as well as emergency conditions.

Two examples of operational controls developed during EMS improvement relate to spill scenarios. The first case was in reaction to an actual spill event. A liquid sludge spill occurred at the Metro Biosolids Center in early 2000. In response, separate work instructions were created to prevent a future accident and to improve management in the event of a future accident. The second case was a proactive response to reduce the possibility of release to the environment and possible creation of a storm water violation; tarps placed over trailers used for dewatered biosolids transportation are installed inside the building, whereas they used to be tarped outside.

As a result of the EMS, new operational controls were put in place to manage the unregulated but targeted areas of reduction of electricity use, potable water use, landfill waste and separated recyclables, and miscellaneous chemical inventory.

Emergency Preparedness

The emergency preparedness program exceeds regulatory requirements in that annual drills, regular equipment and location inspections, and employee tailgate training on emergency response equipment is included in the EMS audit process. As a direct result of the EMS, the O & M Division has expanded employee, visitor, and contractor participation and awareness of emergency preparedness and developed a process to ensure current hazardous material inventory and response documentation is available.

Evidence received during the audit process identified corrective and preventive actions necessary in the following areas: employee awareness, spill response equipment and documentation monitoring and updates, and alarm and announcement systems upgrades necessary. The upgrades and corrections are monitored through the audit process.

The following examples also demonstrate how the O&M Division continually improves its emergency preparedness based on an assessment of effectiveness. When

problems are discovered, solutions are implemented and tested. Post EMS, the O&M Division performs drills of potential emergency scenarios and keeps records.

- At the Point Loma facility, a hydrogen peroxide spill and fire occurred at 4:00 am, one morning. The operator saw flames, and the fire department and hazardous material crews were called. It was observed that not all of the cleanup crew wore proper safety gear. At the time of the accident, emergency drills were held twice annually. They are considering drills 3 to 4 times per year to improve preparedness.

- Typically, contractors are reluctant to participate in the drills; O&M is considering including drill participation as a contract requirement with a penalty for non-participation. All visitors on-site receive a pass at the guard station which has a map on the back indicating evacuation staging areas, and they are expected to participate in the drills.

Regulatory Compliance Assurance

A third-party certified EMS is required to provide objective evidence of document control and records retention, operational control, emergency preparedness and response, monitoring and measurement, and a functional corrective and preventive action system for tracking and resolving non-conformances found during internal and external EMS audits, compliance inspections by regulatory agencies, and other internal informal means. In addition, top management (individual(s) with executive responsibility for the organization and responsible for the environmental policy) review of internal and external audit findings is required. A standard operating procedure should exist to describe the management review process and those involved. Meeting records provide evidence of review and actions taken. These were not reviewed as part of this study. However, the Cal/EPA Project Manager attended a quarterly management review meeting in February 2001 at the invitation of the O&M Environmental Management Representative. The primary topic discussed was facility progress toward the Division targets and non-conformances found in the recent EMS surveillance audit. Regulatory compliance was included on the agenda and briefly reported.

Responsibility for regulatory compliance is decentralized among the facilities, and resides both inside and outside the O&M Division. Regulatory compliance assurance is supported by internal audits and the corrective and preventive action system created as an element of the EMS. Based on information provided by the O&M Division for the National Protocol, the Division performs regular internal regulatory compliance audits as a result of implementing the EMS and meeting the requirement of the ISO 14001 Standard. Prior to the EMS, the Environmental Monitoring and Technical Services Division (EMTSD) periodically performed regulatory audits of the O&M Division, but the frequency and scope of this service was undefined. As a result of the EMS, EMTSD performs defined semiannual audits and O&M operations and process control staff perform semiannual audits—resulting in quarterly internal audits. Regulatory issues have been identified internally and resolved, in addition to the issues identified by

external inspectors. The extra oversight provided by the internal compliance audits provides a greater degree of environmental protection than primary reliance on less frequent external regulatory inspections to identify problems. In addition, internal record-keeping provides a means to track performance and evaluate corrective and preventive actions over time.

Training Programs

As a result of the EMS, management of employee training records is being improved so that as employees transfer between facilities or Divisions, their training records are available in their current location. In addition, the environmental management representative (EMR) makes available various EMS training materials via the intranet web site for supervisors to use in "tailgate" training sessions with sign-in forms provided to document employee training received.

Employee Involvement and Communication

The ISO 14001 EMS Standard requires a designated Environmental Management Representative. This is a full-time position in the O&M Division supported by a few staff. Each facility has a designated environmental coordinator and a designated energy coordinator. Each facility also has a volunteer recycling coordinator. These functions are performed in addition to their other responsibilities.

O&M administers both Energy Savings and ISO Suggestion Support Programs. These programs provide technical support to employees who make suggestions for improvements. Employees can request assistance from an energy or environmental coordinator to review the suggestion and help provide additional economic analysis or other technical support. Suggestions are improved and then forwarded for review to the Department or City management for awarding employee cash incentives. Credit for the suggestion remains with the employee who originated it and the Division can begin implementation earlier in the suggestion review process.

Internal newsletters are published quarterly to semiannually. An internal website provides much information about the EMS, including:

- Standard operating procedures,
- Links to material safety data sheets,
- Training information, and
- Tips for resource conservation both at work and at home.

Division management credits the EMS with increased Division-wide coordination, cooperation, and communication. The best-of-the-best program facilitates sharing best practices among the facilities.

Supply Chain

With participation in the National Biosolids EMS Partnership, the entire biosolids value chain from industrial pretreatment and pollution prevention programs that impact biosolids quality to final beneficial use or disposal are integrated into the O&M Division's EMS through service level agreements with other Divisions and through contract requirements for contractors.

Contractors are informed of O&M Division's environmental policy, various contract requirements, especially emergency preparedness drill participation and communication of evacuation staging areas.

Performance Tracking

The systems for measuring environmental performance are not described or evaluated in this case study. Future research on the adequacy of the metrics would include addressing the following questions:

1. How are continual improvements made in measurement and what have they been?
2. Are the people responsible for measurement properly trained, and is there independent verification?
3. Are measurement methods and equipment reliable, standardized, and of sufficient accuracy and precision to make conclusions about performance and opportunities for improvement?
4. Are there environmental interactions that are not being measured and tracked adequately?

A pre-EMS baseline (prior to 1999) is not available due to variability in the data from facility repairs and upgrades. O&M tracked electricity use, potable water use, refuse removal, and the number of brands of miscellaneous chemicals stored to track performance in relation to their targets. O&M initially relied on billing information for electricity use data, but billing inconsistencies led O&M personnel to read meters on-site for EMS tracking purposes. Potable water use is metered. Refuse removal reported does not include construction wastes or biosolids. Biosolids are weighed prior to transport to the landfill, and a monthly load check between Metro Biosolids Center and the landfill provides verification that no loads are lost. The number of brands of miscellaneous chemicals was counted during cleanout of flammable materials lockers and counted again once improvements were made.

The EMS improved Division-wide roll-up of targeted performance information on environmental aspects and impacts. This improvement facilitates thinking and behaving as a unified system at the Division level rather than strictly as individual facilities working to achieve environmental improvements.

Audit and Review

The audit and review processes for continual improvement are compliant with the ISO 14001 EMS Standard and are not described or evaluated in this case study.

Environmental Performance Indicators

The environmental performance of the Pilot during the study period of 1998 through mid 2001 is described below. Progress toward objectives and targets, measured environmental performance improvements, and compliance history are analyzed to evaluate whether the O&M Division's EMS provides improved environmental protection.

Progress Towards Objectives and Targets

The four target areas addressed by O&M in their EMS are unregulated impacts and all were, to some extent, being addressed prior to EMS implementation. During the first EMS cycle, the four target areas were reduction of

(1) energy use,
(2) potable water use,
(3) landfill contribution, and
(4) chemical use.

The Wastewater Department put forth an energy management plan in June of 2000, and major facilities were already moving toward energy self-sufficiency to decrease the costs of wastewater treatment and keep user fees in check.

The O&M Division had implemented a paper recycling program, as a component of reducing landfill waste and conserving natural resources. The Metro Biosolids Facility had been constructed, which was reducing the quantity of organic waste going to landfill.

The third target area, reduction of potable water use via water reclamation, has been a focus since the North City Water Reclamation Plant began operation in 1997.

The fourth target area, chemical use reduction, also received attention prior to the EMS. Process optimization is part and parcel of wastewater treatment and includes process chemical reduction at both the facility and system levels. While some chemical processes are arguably more environmentally benign than others, there can be tradeoffs in worker safety and cost. In addition, process chemical reduction is constrained by desired effluent quality and odor control. While the reduction of process chemical use was initially identified as a target area--including use of ferric chloride, polymers, sodium hydroxide, hydrogen peroxide, sodium hypochlorite, and softener salt--changes in operation, including repairs and upgrades, at the pump stations and major facilities during the baseline and first cycle of the EMS made this target unworkable at the Division level. To retain focus on chemical use, the Division chose to target reduction in use of miscellaneous chemicals, including solvents, stored in flammable materials lockers.

San Diego MWWD O&M met all four of its targets set for the year 2000, and exceeded three of the four as shown in Table 2. Electricity use was reduced 5%, potable water use was reduced 6%, refuse removal was reduced 19%, and miscellaneous chemical inventory was reduced 13%. New objectives and targets have been set for this fiscal year ending June 30, 2002. Bulk and miscellaneous chemical use will be tracked. Ten percent reduction goals are set for electricity use, potable water use, refuse removal, and a new objective and target is set for notices of violations received from environmental regulatory inspections.

Table 2 Objectives and Targets

Objective	Target	Status	Regulated		Non-Regulated
			Meets	Beyond	
Reduce electricity use in 2000	5% from 1999	Achieved 5% reduction			X
Reduce potable water use in 2000	5% from 1999	Achieved 6% reduction			X
Reduce refuse removal in 2000	5% from 1999	Achieved 19% reduction			X
Reduce miscellaneous chemical use in 2000	5% from 1999	Achieved 13% reduction			X
Track bulk chemical use in FY 01/02	none	in progress			X
Track miscellaneous chemical use in FY 01/02	none	in progress			X
Reduce electricity use in FY 01/02	10% from FY 99/00	in progress			X
Reduce potable water use in FY 01/02	10% from FY 99/00	in progress			X
Reduce refuse removal in FY 01/02	10% from FY 99/00	in progress			X
Reduce Notices of Violations in FY 01/02	10% from FY 99/00	in progress	X		

Data sources: University of North Carolina National Database Report, EMS Design Table 5: Planned Dates of Objectives and Targets; and Design Update Section 6.

Pre and post EMS Environmental Performance

Table 3 contains the data supporting the target area reductions for electricity use, potable water use, refuse removal, and a number of different brands of miscellaneous chemicals. The Pilot only measured performance in areas that were targeted through its EMS. The large apparent reduction in solid waste between 1998 and 1999 is due to a change in measurement method. Beginning in 1999, construction contractors were made responsible for collecting and transporting construction wastes. Thus, construction waste management is considered outside the scope of the O&M EMS and 1999 became the base year for comparing solid wastes generated by facility operations.

Table 3 Environmental Performance Measurements

Indicator	Baseline Data				Update Data	
	1998		1999		2000	
	Non-Normalized	Nor-malized*	Non-Normalized	Nor-malized*	Non-Normalized	Nor-malized*
Electricity usage, MWHrs/Month	9837	N.A.	9801	N.A.	9281	N.A.
Potable water usage, hundred cubic feet	55323	N.A.	39759	N.A.	37373	N.A.
Refuse removal, tons per month	43.63	N.A.	26.65	N.A.	21.65	N.A.
Miscellaneous chemicals, number of brands	--	N.A.	1269	N.A.	1093	N.A.

Data sources: University of North Carolina National Database Report, Baseline Table 2: Environmental Performance Indicator Values; and Update Table 4: Environmental Performance Indicator Values.

N.A.: Not applicable

*Data are summarized at the Division-level, which increases the complexity of normalization due to the different types and capacities of facilities. Currently, the O&M Division does not base its impact reductions on normalized measurements—for example, impact measurements in proportion to the wastewater treatment services it provides.

Performance Compared to Regulatory Requirements

No data are reported in Table 4, because targets set by San Diego MWWD O&M during the past cycle were for non-regulated impacts. It is outside the scope of this case study to report and analyze facility-level performance information relative to regulatory requirements due to the large number of facilities and equipment-specific permits.

Table 4 Environmental Performance Compared to Regulatory Requirements

Regulatory Requirement			Objective and Target (if identified for regulatory requirement)	Environmental Performance Measure				
Permitted Emission	Regulation	Permit Limit		1996	1997	1998	1999	2000
			No objectives and targets for regulatory requirements.					

Compliance Performance

Based on regulatory compliance data, no improvement is evident. However, non-compliances and potential non-compliances discovered and resolved though the O&M EMS compliance audit process are evidence that improved environmental protection is in place. It is not possible to say with certainty, but the increase in potential non-compliances may be the result of improved internal auditing. The effort expended by the Division Environmental Management Representative and responsible staff in completing the compliance section of the National Protocols prompted them to include regulatory compliance performance in their current cycle of objectives and targets (see Table 2).

Table 5 Compliance Information

Infraction	Baseline			Update		
	1996	1997	1998	1999	2000	1/1/01-6/30/01
Major Violation	N.R.	N.R.	N.R.	N.R.	1-no fine 1-awaiting RWQCB action	N.R.
Minor Violation	N.R.	1-$250	1-$500	1-$3000 1-no fine	3- $250 to $1500 2-no fines	1-$2500
Non-Compliance	N.R.	N.R.	N.R.	1	2	N.R.
Potential Non-Compliance	N.R.	N.R.	N.R.	1	4	10

Note: Most EPA enforcement policies explicitly utilize "Major, significant (moderate) and minor" classifications to determine the appropriate enforcement response to a given violation. A non-compliance is an infraction either discovered by the regulated party or environmental agency that does not lead to violation. A potential non-compliance is a situation that is discovered and corrected before a violation could occur.

N.R.: None reported.
Data Sources: University of North Carolina National Database Report, Baseline Report 3: Violation Report; Baseline Report 4: Non-compliance/Potential Non-Compliance Report; and Update Report 5: Violation Report; and Update Report 6: Non-compliance/Potential Non-Compliance Report.

Objective 2 Environmental Information

The O&M Division EMS is certified to the ISO 14001 voluntary global EMS Standard. There is a suggestion in the ISO 14004 EMS guidance document to include consideration of stakeholder concern when evaluating significance of environmental aspects and impacts of the organization's activities, products, and services, but no requirement. The ISO 14001 EMS Standard requires that "the organization shall establish and maintain procedures for receiving, documenting, and responding to relevant communication from external interested parties." In addition, "the organization shall consider processes for external communication on its significant environmental aspects and record its decision." There is no requirement for involving interested parties in EMS development, implementation, and review, and there is no requirement for providing better environmental information than that required by the regulatory system.

Based on O&M Division's participation in the Cal/EPA EMS Pilot Project, the National Biosolids Partnership EMS Project, and the fact that it is a public agency, their EMS is helping them to increasingly involve interested parties in continual improvement efforts and provide improved environmental information to the public.

Public and Stakeholder Involvement in EMS Development, Implementation and Review

In the early stages of EMS design and implementation, Gordon Innes of the State Water Resources Control Board facilitated a local advisory group comprised of regulators and community members that provided suggestions to the O&M Division.

Cal/EPA established stakeholder Working Groups in both Southern and Northern California to enlist stakeholder involvement and advice in meeting the objectives of the Cal/EPA EMS Pilot Project as well as to provide a forum for stakeholder input into each pilot's EMS. Participation in a Cal/EPA Working Group was a requirement for selection as a pilot project. The O&M Division participated in the Southern California Working Group and hosted an on-site meeting and facility tour on April 4, 2001. The O&M Division's participation on the Working Group, including the EMS training sessions, was considered by their Environmental Management Representative to be a valuable venue for collegial information sharing among peers regarding EMSs. In addition, based on verbal and written comments from those attending the hosted meeting, it provided an in-depth understanding of O&M's EMS and of their environmental responsibilities.

Whether improvements were made in O&M's EMS due specifically to stakeholder input from the Cal/EPA Southern California EMS Working Group is unknown. Because Southern California Working Group meetings were held in the Los Angeles area, few interested parties from the San Diego area made the trip.

However, as a direct result of involvement in the Cal/EPA Pilot Project, Division management chose to improve the Division-level focus on environmental compliance improvements through the framework of their EMS. As reported in the National Protocols, the new target set for 10% reduction in the number of notices of violations received from environmental regulatory inspections is due to the effort expended by the Division Environmental Management Representative and responsible staff in completing the regulatory compliance section of the National Protocols.

While the scope of the original ISO 14001 certification addressed only those environmental aspects that are within the authority of the Operation and Maintenance Division to control, they have more recently integrated the National Biosolids Partnership EMS into their ISO 14001 EMS. The National Biosolids The partnership includes the Water Environment Federation, the Association of Metropolitan Sewerage Agencies and the U.S. EPA. Participation in this program is a highly effective venue for interested party involvement in continual improvement of O&M's EMS. Integration of the biosolids EMS with the ISO EMS required service level agreements between San Diego Metropolitan Wastewater Department, Operation and Maintenance Division and the Industrial Pretreatment and Pollution Prevention Programs in the Department as well as the landfill where biosolids are disposed. Increased public outreach with regard to biosolids management is a required element and beneficial use of biosolids is strongly encouraged.

Improvements in Accessibility and Quality of Information

A list of information that is now available to the public as a direct result of the EMS is provided in Table 6. O&M is a public agency and is required under the Freedom of Information Act to provide information to the public when it is requested through established processes. To the extent that the EMS is continually improving management of environmental impacts and record keeping by the Division, then it would be expected that in cases where the public requests information, improvements are continuing to be made. Prior to the September 11 terrorist attacks in New York City and Washington, D.C. in 2001, the Metropolitan Wastewater Department regularly offered facility tours to interested groups. With greater security concerns, they are reevaluating their public access policy. In addition to responding to requests, the City of San Diego maintains a website with detailed information about the Wastewater Department.

The MWWD website[3] displays the sewer spill hotline number, and provides navigation to more information in the following categories: general information, community concerns, news, innovations in wastewater, and frequently asked questions. The Metropolitan Wastewater Department organizational chart and a map of the sewerage system, with links to facility descriptions, are provided as part of the general information to help the public understand both the human system and physical system that operates on their behalf. Facility addresses are provided, which are necessary for inquiries to environmental regulatory authorities as to regulatory performance.

In addition, information about participation in the National Biosolids Partnership voluntary Environmental Management System Pilot Program is provided on the website as well as the requirement that agencies participating in the EMS program develop solutions to environmental concerns in the communities which generate and the communities which receive biosolids.

[3] The website address is http://www.sannet.gov/mwwd/index.shtml

Table 6 Environmental Information Type and Availability to Public

Information Subject	Legal Reporting Requirement		Location of Public Information					
	Yes	No	Web site	Public Relations Dept.	News-letter	Annual Report	Environmental Agency	Upon request
EMS Policy		X						X
EMS Env. Aspects		X						X
EMS Env. Impacts		X						X
EMS Objectives and Targets		X						X
Operation and Procedures		X						X
Compliance information	X						X	X
Hazardous waste generation	X						X	X
Air emissions	X						X	X
Water discharge	X	X					X	X
Resource use: energy		X						X
Resource use: water		X						X
Resource use: materials		X						X
Solid Waste		X						X
TRI		NA						NA
Prop. 65	X							X

N.A.: Not applicable.
Data Sources: California Supplemental Protocols

Objective 3 Economic Incentives and Barriers to EMS Implementation

Economic data were not available from the O & M; therefore, an analysis of economic costs and benefits of EMS implementation is not included in this case study.

Objective 4 Successes and Challenges with EMS Implementation

Each pilot project offers unique experiences that provide lessons on the challenges and successes of EMS implementation. These lessons help develop an understanding of the important elements for successful EMS implementation and how an EMS can

improve environmental protection. Lessons from the O&M Division's EMS implementation are described below.

The scope of certification is being expanded from the Division to the Department level. In addition to Department level certification, separate certifications are being pursued by the Collection Division (certification scheduled for May 2003) and the Environmental Monitoring and Technical Services Division (certified June 2002). An important lesson from the O&M Division's experience is to start where success is likely and build. This approach reduces the risks of failure of the innovation and increases the ability of the organization to learn by doing.

The O&M Division, in addition to a very capable staff, had a leader in Chris Toth, the Division Deputy, that provided frequent and effective communication to the organization for rising to the challenge of implementing the ISO 14001 EMS. He was quick to point out how small the gap was between where they were and where they needed to go and how much more they could achieve together by closing the gap. He constantly reminded people that they were in the business of the environment and while the vocabulary was new, the requirements were consistent with current objectives and practice, only perhaps more systematic. The Environmental Management Representative, Linda Jones, was an extremely effective and trusted communicator with people on a face-to-face and one-to-one basis as they received training, provided feedback, and completed the required Standard Operating Procedures and work instructions necessary for successful implementation. Additional champions were found in designated facility environmental and energy coordinators as well as volunteer recycling coordinators.

ISO 14001 certification adds value to the O&M Division by having an independent review and creating an outward focus to stimulate innovation and improvement as well as driving a timeline for accomplishments.

The remaining discussion of challenges and successes is organized by target area.

Electricity Use

Energy use was identified as a significant environmental impact within the facilities. In an effort to promote a reduction in this area, a Department Energy Management Committee was established in 2000 to review energy consumption, monitor the effectiveness of the co-generation facilities, and develop a plan to reduce energy use within the plants. Contracted through a private consulting firm, energy audits identified process optimization opportunities. Additionally, energy teams made up of volunteer staff members were trained to identify energy saving opportunities—to identify the “low hanging fruit." An energy suggestion program was established to solicit ideas and suggestions for energy reductions from line employees. The Gas Utilization Facility was upgraded with efficient engines, increasing electricity production for the Point Loma treatment facility and providing the excess power to the grid for use in San Diego homes.

Operating permits were modified for the main pumping station to permit increased operations of the gas powered engines in support of reducing the negative impact of the California energy crisis, and 10 stations were identified that can operate solely on generator power during emergency situations. Low energy use equipment and flow management have reduced total electricity use for calendar year 2000. Future energy savings for fiscal year 2002 will be realized as a result of the Pump Energy Recovery Plant that began operation June 2001.

While increasing energy efficiency has received much attention at the State level—via the Governor's directive for energy efficiency—and the City of San Diego has long made it a priority, change management in the form of justification, planning, and design for capital improvement projects, that typically require three or more years to complete, are driven at the Metropolitan Wastewater Department level. The Metropolitan Wastewater Department was the first City Department to complete a comprehensive energy management plan. It is a Department-level commitment to reduce power consumption, conserve natural resources and pass savings to ratepayers.

According to John Paschall, the Department Energy Coordinator, the fact that the O&M Division had an EMS increased organizational efficiency in rolling out the energy management plan. A system is already in place to manage environmental impacts generally and does not have to be recreated as energy concerns or other environmental concerns rise to crisis levels.

There was much consideration given to selecting an energy use metric that would give a fair picture of environmental impact reduction. Total electricity use was chosen as a metric to keep focus on continual improvements in energy efficiency at the Division-level. Increasing the proportion of "green" energy used to that purchased from the grid was considered as well as increasing self-sufficiency to free up power available to the community.

"Green" energy is defined by O&M as energy produced from methane generated by wastewater treatment processes and landfilled waste decomposition, energy produced by the new hydroelectric generator, and thermal energy recovered through cogeneration used for heating, and through absorption chilling to air-condition the Metro Biosolids Center. The Point Loma Wastewater Treatment Plant, the Metro Biosolids Center, and the North City Water Reclamation Plant make use of energy produced from methane as well as thermal energy. The Metro Biosolids Center and the North City Water Reclamation Plant also use energy from landfill gas collection at the Miramar Landfill.

Purchased electricity was reduced when the gas utilization facility came online at Point Loma in November 1999. The gas utilization facility can produce a total of almost 4.5 megawatts per hour, making Point Loma energy self-sufficient and enabling them to sell power back to the grid. Overall energy use increased at Point Loma, because running the gas utilization facility requires a net increase in total energy use. A recently rehabilitated hydroelectric project that makes use of the drop in elevation of the outfall at

Point Loma generates up to 1.35 megawatts. The Metro Biosolids Center privatized cogeneration facility can generate 6.4 megawatts and MBC uses about half that for its operations, while the North City privatized cogeneration facility produces 3.8 megawatts on average and North City requires a minimum of three-fourths of that to operate. Excess power generated from the facilities is sold by the private company for use by San Diego electric customers.

While increasing self-sufficiency, especially during power emergencies, was not pursued as a performance metric for the O&M EMS, it is a Department-level objective and important changes were made. During power emergencies, remote control of emergency generators can make 2.2 megawatts available to the local electric grid, in part made possible by a grant from the California Energy Commission.

Potable Water Use Reduction

Reduction in potable water use was achieved by increasing organizational focus brought about by target setting and resulted in improvement in communication between employees and management facilitated by performance reporting and management review. While it was recognized by facility management at the Metropolitan Biosolids Center that the quantity of reclaimed water in proportion to potable water used for facility processes was far lower during operation than had been intended by design, the reason behind the discrepancy remained undiscovered until potable water use reduction was identified as an EMS target. To resolve the discrepancy, design and construction blueprints as well as past construction managers were consulted. It was discovered that a major valve in an underground pipeline which ties Metro Biosolids Center to the North City water reclamation plant had been left partially closed. Once the valve was opened, the Metro Biosolids Center was able to make use of the available reclaimed water—utilizing 97% reclaimed water. Division management credits the focus facilitated by EMS requirements with the improvement in communication and resulting decrease in problem resolution time.

Other water conservation measures include low flow fixtures, landscape modifications, monitoring irrigation systems, and controlling water use during truck wash downs at the pumping station. Future potable water savings will be increased with the development of a reclaimed water plant for the treatment facility.

Landfill Contribution

The reduction in refuse removal was achieved through expanding recycling programs, primarily from improving the paper recycling program, which predated the EMS, and adding a green waste separation program. Additional reduction in landfill contribution will be achieved through dewatering biosolids at the Metro Biosolids Center. Construction wastes are managed by contractors and are not measured or diverted by the O&M Division.

Recycling efforts have been expanded at all facilities by:

- Relocating and making recycling bins available at all facilities including the outlying stations,
- Developing promotional and educational materials,
- Contracting with a reliable company to remove the recycled paper and cardboard on a regular basis,
- Including greenery in the program, and
- Staffing each location with staff volunteer recycling coordinators.

Improvement in the paper recycling program that existed prior to the EMS came directly from implementation of the plan, do, check, adjust cycle of continual improvement required by an EMS—specifically, the "check" requirement. During an internal EMS audit, it was discovered that separated paper was not being transported to the paper recycling contractor as intended, but was being transported directly to the landfill by an O&M Division employee. The separated paper had been continually refused by the recycling contractor due to excessive contamination, in response, the employee, began taking the paper directly to landfill. Once management was made aware of the problem, improvements were made to reduce contamination and paper is now recycled as intended.

Future reduction in landfill contribution will come from two efforts at the Metro Biosolids Center: (1) biosolids dewatering to 25% solids and (2) diversion of a large fraction for beneficial use in land application. A Biosolids Management Plan was created at the Department level and gives direction for years 2001-2011. Between 300 and 400 tons per day of biosolids are landfilled. Biosolids are landfilled at the Allied landfill on Sycamore, which collects methane for energy recovery. Biosolids are not accepted by Miramar landfill, which is near the facility, because of odor complaints. Prior to landfilling, biosolids were transported to Yuma, Arizona for beneficial use in agriculture. The current landfill contract provides a savings of $7/ton over current beneficial use opportunities and reduced the transportation impacts associated with hauling to Yuma. The O&M Division goal is to obtain a modification on their landfill contract, which is locked in for several years, to allow 200-250 tons per day to be sent to a compost facility. They just completed the digester upgrade to produce class B biosolids which can be accepted by compost facilities. Existing digesters cannot handle the increased temperatures necessary to produce class A biosolids for land application. They are exploring alternatives to produce class A, but it requires large capital expenditures and typically three years to complete capital improvements. In addition, suitable land application sites are needed.

Miscellaneous Chemical Reduction Program

The reduction in miscellaneous chemical inventory was accomplished by cleaning out flammable material storage lockers, creating an authorized purchase list to limit different chemicals used for the same purpose and limiting the use of different brands. In addition, the practice of accepting samples of various chemicals from sales people visiting the facilities was discontinued. Facility managers maintain tighter control on

miscellaneous chemical purchases and promote proper application and housekeeping procedures.

Objective 5 Describe observations regarding the first generation EMS development and implementation experience for a government/public sector organization as well as the experience gained during the cycle of continual improvement

The O&M Division participated in the Cal/EPA Pilot Project with openness and transparency. While it was not a requirement of participation, the Division allowed the Cal/EPA Project Manager to participate in a management review meeting and attend a certification surveillance audit as a silent observer. O&M also was helpful in reviewing raw performance data with the Cal/EPA staff to clarify impact reductions. These experiences allowed the Project Manager to make direct observations regarding EMS effectiveness as well as to question and more clearly explain reported improvements. When requested as part of the National EMS Protocol, detailed information was shared on both external regulatory compliance inspection results and internal regulatory compliance audit results. Other observations regarding EMS implementation at a public agency and changes made through the first cycle of target setting are described previously in the case study, where relevant.

5.0 Findings

Objective 1 Environmental Protection

- With the integration of the National Biosolids Partnership EMS, the O&M Division expanded its management system to include environmental controls on the entire biosolids value chain, from pollution prevention and industrial waste treatment programs through the effluent outfall and biosolids disposal, composting, or land application sites. Beneficial use is strongly encouraged and is being pursued by O&M as a result of the partnership. This expanded commitment to systematic management was adopted through a partnership between the wastewater industry and government. The Biosolids EMS is proving to be a useful tool to hasten the adoption of best practices. It is an example of reinvention as well as an example of the role of respected peers described by Everett Rogers in *Diffusion of Innovations,* 4th edition.

- The exercise of identifying significant environmental aspects and impacts requires priority-setting at the Division level and is a prerequisite to integrating environmental improvement initiatives with budget planning cycles and capital project planning. This exercise helped identify opportunities for proactive management that reliance on regulatory inspections would not be expected to uncover or necessarily communicate to top management. A Division-level management approach to reducing unregulated environmental impacts was put in place as a result of the EMS.

- Prior to the EMS, development of operational control procedures for critical control points was prioritized based on complexity of the operation. Post-EMS, operational control development priorities are set based on the degree of significance of the environmental impact under normal operating as well as emergency conditions. Two examples of operational controls developed during EMS improvement were in response to (1) an actual spill event and (2) a proactive response to a foreseeable spill scenario. As a result of the EMS, new operational controls were put in place to manage the unregulated but targeted areas of reduction of electricity use, potable water use, landfill waste, and miscellaneous chemical inventory.

- The extra oversight provided by the semiannual internal compliance audits and management review of corrective and preventive action reports provides a greater degree of environmental protection than primary reliance on external regulatory inspections to identify problems. Because the O&M Division is a public agency, the internal record-keeping provides a means not only for management but also for interested parties to track performance and evaluate corrective and preventive actions over time.

- Division management credits the EMS with increased Division-wide coordination, cooperation and communication. The best-of-the-best program facilitates sharing best practices among facility personnel. The EMS improved Division-wide roll-up of targeted performance information on environmental aspects and impacts—facilitating thinking and behaving as a unified system at the Division level rather than primarily working toward individual facility accomplishments.

- The O&M met or exceeded all four of its reduction targets set for the year 2000

- Progress was made in addition to the targeted metrics in support of O&M's objectives, including increasing green power generation and supply to the grid and remote control of back-up generators to make power available to the community during power emergencies.

- No improvement in regulatory compliance is evident. However, non-compliances and potential non-compliances discovered and resolved though the O&M EMS compliance audit process are evidence that improved environmental protection is in place. It is not possible to say with certainty, but the increase in potential non-compliances may be the result of improved internal auditing. The effort expended by the Division Environmental Management Representative and responsible staff in completing the compliance section of the National Protocols prompted them to include regulatory compliance performance in their current cycle of objectives and targets.

- While no improvement in the number of notices of violations from environmental regulatory agencies was observed over the study period, due to the Division's experience of communicating regulatory performance required by participation in

the Cal/EPA EMS Project and the National EMS Database funded by U.S. EPA, management set a target for 2002 to reduce notices of violations from environmental regulatory agencies.

- The extra oversight provided by the O&M Division's semiannual internal compliance audits and management review of corrective and preventive action reports provides a greater degree of environmental protection than primary reliance on external regulatory inspections to identify problems. Because the O&M Division is a public agency, the internal record-keeping provides a means not only for management but also for interested parties to track performance and evaluate corrective and preventive actions over time.

- Through its EMS, the O&M Division improved its ability to proactively manage and communicate its reduction of potential as well as ongoing negative environmental impacts. Notable improvements were made in the areas of operational controls, emergency preparedness, and targeted reductions in unregulated impacts. The O&M Division achieved significant reductions in electricity use, potable water use, refuse removal, and miscellaneous chemical inventory.

Objective 2 Environmental Information

- Improved environmental information is provided to the public as a result of EMS implementation at the O&M Division. Increased public and stakeholder input into EMS development, implementation, and review was observed and the public's access to and quality of information about environmental and health impacts, performance, and systems for protection improved.

- Based on O&M Division's participation in the Cal/EPA EMS Pilot Project, the National Biosolids Partnership EMS Project, and the fact that it is a public agency, their EMS is helping them to increasingly involve interested parties in continual improvement efforts and provide improved environmental information to the public.

- The O&M Division's participation on the Cal/EPA Southern California EMS Working Group, including the EMS training sessions, was considered by their Environmental Management Representative to be a valuable venue for collegial information sharing among peers regarding EMSs and other best practices. In addition, based on verbal and written comments from those attending the hosted meeting, it provided an in-depth understanding of O&M's EMS and of their environmental responsibilities, challenges, and successes.

- As a direct result of involvement in the Cal/EPA Pilot Project, Division management chose to improve the Division-level focus on environmental compliance improvements through the framework of their EMS.

- Participation in the National Biosolids Partnership (composed of the Water Environment Federation, the Association of Metropolitan Sewerage Agencies, and the U.S. EPA) is a highly effective venue for interested party involvement in continual improvement of O&M's EMS. Increased public outreach with regard to biosolids management is a required element, and beneficial use of biosolids is strongly encouraged.

- Through their EMS, the O&M Division is continually improving management of significant impacts and record keeping; thus, it is expected that in cases where the public requests information, improvements are continuing to be made. Prior to the September 11 terrorist attacks in New York City and Washington, D.C. in 2001, the Metropolitan Wastewater Department regularly offered facility tours to interested groups. With greater security concerns, they are reevaluating their public access policy. In addition to responding to requests, the City of San Diego maintains a website with detailed information about the Wastewater Department.

Objective 3 Economic Incentives and Barriers to EMS Implementation

Economic indicators were not available from the O & M Division; therefore, an analysis of economic costs and benefits of EMS implementation is not included in this case study.

Objective 4 Successes and Challenges with EMS Implementation

- The EMS has provided the O&M Division, the division within MWWD with direct responsibility for most of the energy-intensive facilities management, an improved framework to measure, communicate, and manage their progress. The fact that the O&M Division had an EMS increased organizational efficiency in rolling out the Department-level energy management plan. There is added value in having a system in place to manage environmental impacts generally, so that organizational systems and processes do not have to be recreated as energy concerns or other environmental concerns rise to crisis levels.

- Reduction in potable water use was achieved by increasing organizational focus brought about by target setting and resulted in improvement in communication between employees and management facilitated by performance reporting and management review.

- Expansion of the recycling program was driven by identifying landfill contribution as a significant impact and setting an improvement target. Improvement in the paper recycling program came directly from implementation of the "plan, do, check, adjust" cycle of continual improvement required by an EMS—specifically, the "check" requirement. Construction waste reduction was excluded from the scope of the O&M Division EMS, leaving this as an area of opportunity for improved supply chain management.

- When an initial target for process chemical reduction became unworkable at the Division level during the first cycle, the organization chose to modify the target to reduce miscellaneous chemical inventory.

Objective 5 Observations on EMS development and implementation experience

- While self-reported information collected through standardized survey instruments such as the National EMS Database and California Protocols can be very useful for performance evaluation purposes, direct observations by the Cal/EPA Project Manager during a management review meeting, a third-party certification surveillance audit, and review of raw data with staff provided more clarity and credibility to the case study analysis and findings.

- Public information and interested party involvement in EMS development, implementation, and review is not required by the ISO 14001 Standard, however, an EMS provides a valuable framework for interested parties to become engaged in continual improvement of an organization and its impacts, should the organization choose to show leadership in this area—as the O&M Division has.

6.0 Conclusions of the San Diego Metropolitan Wastewater Department Operation and Maintenance Division EMS Pilot Project

The continual improvement nature of EMSs distinguishes this approach from compliance maintenance, and therefore, when pursued by public agencies, can be expected to increase environmental protection and public information beyond that required by the regulatory system. In the case of the San Diego Metropolitan Wastewater Department Operation and Maintenance Division, additional protection and improved information was reported by the Division and observed by the Cal/EPA Project Manager. Additionally, the O&M's successful experience with EMS adoption is spreading to the entire Department as well as to other sections of City government. Strong leadership at all levels, effective implementation and system management, partnerships with regulators and other stakeholders, and third-party certification have been important factors in their success.

The EMS has provided the O&M Division, the division within MWWD with direct responsibility for most of the energy-intensive facilities management, an improved framework to measure, communicate, and manage their progress. The fact that the O&M Division had an EMS increased organizational efficiency in rolling out the Department-level energy management plan. There is added value in having a system in place to manage environmental impacts generally, so that organizational systems and processes do not have to be recreated when energy concerns or other environmental concerns rise to crisis levels.

The role of government as convener, educator, and facilitator was a necessary catalyst to meaningful and constructive dialogue between organizations with EMSs and interested parties. Cal/EPA's collaboration with U.S. EPA and participation in the Multi-State Working Group were necessary catalysts for the EMS Pilot Projects. In turn,

Cal/EPA's leadership at the State level and the active participation of industry, consultants, academia, local and regional governments, regulatory agencies, and public interest groups in the Northern and Southern California EMS Working Groups were necessary to break through the learning curve and articulate opportunities and challenges posed by the growing voluntary and regulatory use of environmental management systems. Education of stakeholders about the elements and requirements of EMSs is necessary to help them know what to ask for and how to effectively engage regulated organizations in productive dialogue. In this way, timeliness, relevance, and completeness of information are improved.